What Makes for Success in Science and Engineering Collaboratories?

Judith S. Olson

Gary M. Olson

Erik Hofer

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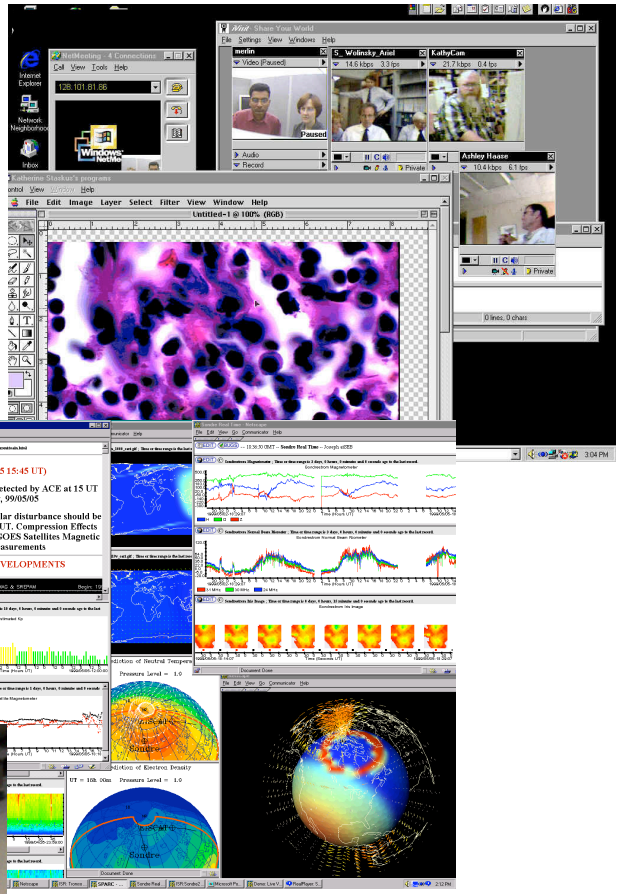
Collaboratories…

- Laboratories without walls
- Connect people to
  - Expensive equipment
  - Large data sets
  - Each other
- for the basic conduct of science and engineering

Examples

- Great Lakes CFAR
- UARC/SPARC
- NEES



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Science of Collaboratories Project

- Perform a comparative analysis of collaboratory projects
- Develop general principles and design methods
- Test these principles on existing or upcoming collaboratories
- Develop of a Collaboratory Knowledge Base
  - technical and social data and detailed findings from existing collaboratory projects

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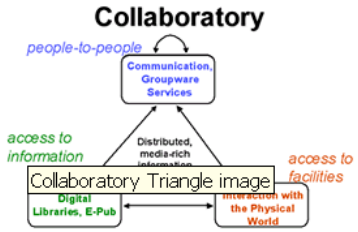
Science of Collaboratories Home

For more than a decade a number of collaboratory projects have been carried out in a variety of scientific and engineering fields. Most collaboratories have been built as one-off, hand-crafted projects. We seek to change this. The Science of Collaboratories (SOC) project is devoted to understanding the technical and behavioral principles that can lead to better, more successful design of collaboratories in the future.
Please explore this web site to learn more about:

- the SOC project overview,
- our mission
- the project activities
- the partner organizations involved
- the research team
- and, as the project proceeds, our findings and results.



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This material is based upon work supported by the National Science Foundation under Grant No. IIS 0085951. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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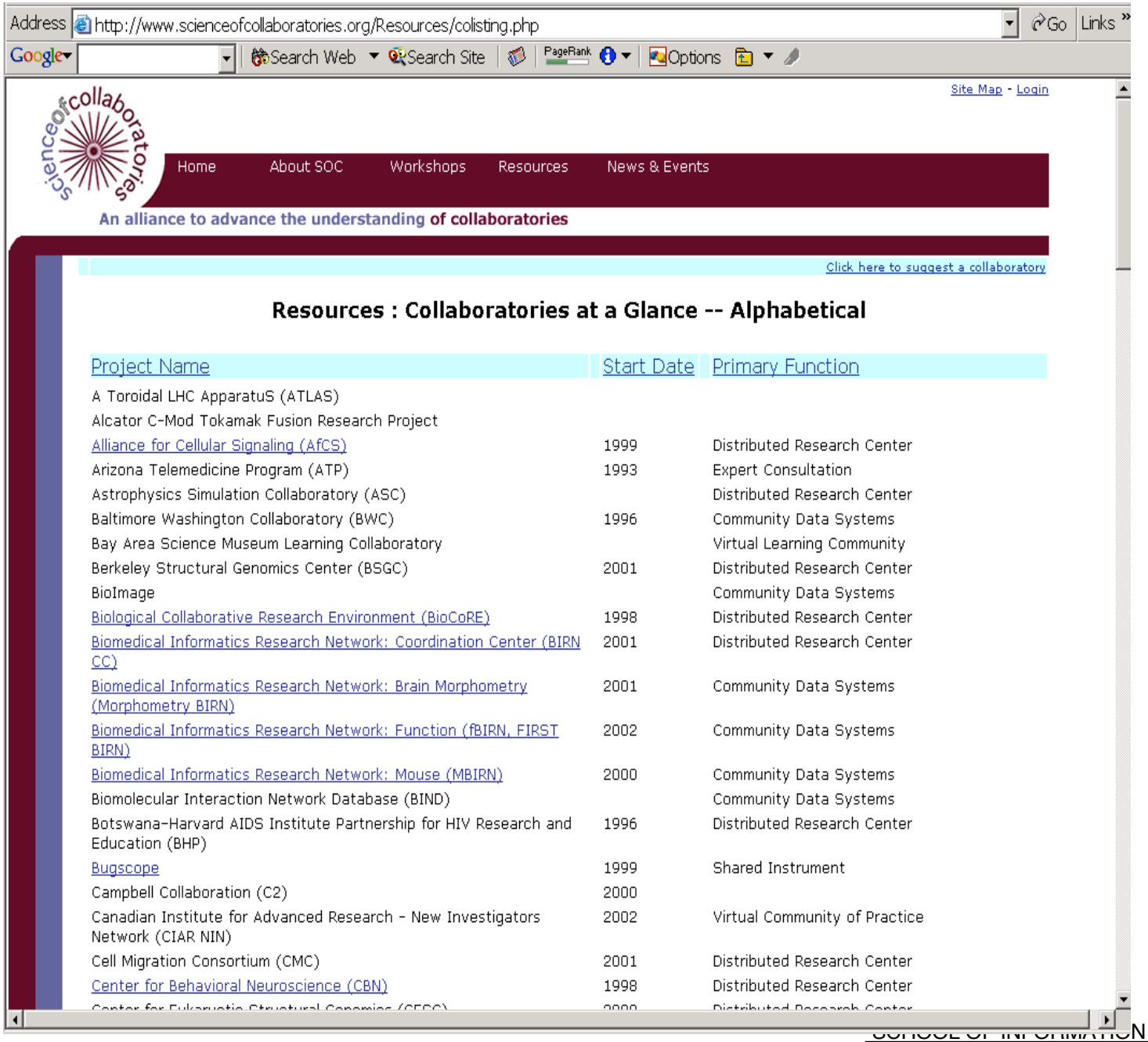
Collaboratories at a Glance

- Collect a large set of collaboratories
  - We have identified almost 200 examples
- Collect a basic set of information
- Note similarities and differences on both technical and social dimensions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Resources : Collaboratories at a Glance -- Alphabetical
Project Name | Start Date | Primary Function
A Toroidal LHC ApparatuS (ATLAS)
Alcator C-Mod Tokamak Fusion Research Project
Alliance for Cellular Signaling (AfCS) | 1999 | Distributed Research Center
Arizona Telemedicine Program (ATP) | 1993 | Expert Consultation
Astrophysics Simulation Collaboratory (ASC) | | Distributed Research Center
Baltimore Washington Collaboratory (BWC) | 1996 | Community Data Systems
Bay Area Science Museum Learning Collaboratory | | Virtual Learning Community
Berkeley Structural Genomics Center (BSGC) | 2001 | Distributed Research Center
BioImage | | Community Data Systems
Biological Collaborative Research Environment (BioCoRE) | 1998 | Distributed Research Center
Biomedical Informatics Research Network: Coordination Center (BIRN CC) | 2001 | Distributed Research Center
Biomedical Informatics Research Network: Brain Morphometry (Morphometry BIRN) | 2001 | Community Data Systems
Biomedical Informatics Research Network: Function (fBIRN, FIRST BIRN) | 2002 | Community Data Systems
Biomedical Informatics Research Network: Mouse (MBIRN) | 2000 | Community Data Systems
Biomolecular Interaction Network Database (BIND) | | Community Data Systems
Botswana-Harvard AIDS Institute Partnership for HIV Research and Education (BHP) | 1996 | Distributed Research Center
Bugscope | 1999 | Shared Instrument
Campbell Collaboration (C2) | 2000 |
Canadian Institute for Advanced Research - New Investigators Network (CIAR NIN) | 2002 | Virtual Community of Practice
Cell Migration Consortium (CMC) | 2001 | Distributed Research Center
Center for Behavioral Neuroscience (CBN) | 1998 | Distributed Research Center

In-depth

- SPARC/UARC
- GLR CFAR
- Bugscope
- EMSL
- NEESgrid
- InterMed
- GriPhyN
- iVDGL
- AfCS
- BIRN

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Theory of Remote Collaboration (TORC)

- Factors that lead to success in remote science and engineering

- Based on SOC cases and literature
  - Social studies of science
  - Sociology
  - Social psychology
  - Computer supported cooperative work

What is Success?

- Effects on the Science itself
- Effects on Science Careers
- Enhanced Science Education
- Inspiration to others
- Public perception
- Reuse of collaboratory tools

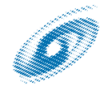
Factors That Affect Success

- The Nature of the Work
- Common Ground
- Collaboration Readiness
- Management, Planning and Decision Making
- Technology Readiness

Technical readiness

- Right functionality, easy to use
- Comfortable with the technology
  - People can't make too big a leap
- Technology gives benefit to participants

- Reliable
- Common platform
- Adequate networking



Technical readiness

- Technical support at each location
- Technical coordinator

- If data sharing: defacto standards
- If instrument sharing: certify remote users

The nature of the work

- The more partitionable the work, the easier it is to do long distance
  - May not want total independence
  - Need interaction to avoid drift
  - Some success with standardization

Common ground

- Mutual knowledge, beliefs and assumptions

- People who have worked together before successfully presumably have worked this out
- Common vocabulary
- Common management or working style

Veinott et al study

- The less common ground you have, the more you need high bandwidth and rapid interaction for communication
  - Pairs of Native English speakers do not need video to communicate
  - Pairs of Non-native English speakers are *much* better when they have video as well as audio

Collaboration readiness

- The community has to have a spirit of collaboration.
- Motivation to work together:
  - Mix of skills
  - Greater productivity
  - Like working together
  - Something in it for everyone
  - NOT
    - Mandate from the funder
    - The only way to get the money
    - Asymmetries in value, etc.

Collaboration Readiness

- Trust
  - Reliable
  - Produce high quality work
  - Have their best interests at heart
- Goals aligned
- Group self-efficacy

Management, planning, and decision making

- Principals have time to do the work
- Distributed participants can communicate in real time > 4 hrs a day
- There is a critical mass at each location
  - And a point person at each location

Management, planning, and decision making

- Management plan
- Project manager is respected and has project management experience
- Communication plan
- Plan has room for reflection and redirection

Management, planning, and decision making

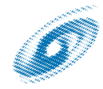
- No legal issues remain
- No financial issues remain
- Knowledge management system
- Decision making is
  - Free of favoritism
  - Fair and open
  - Everyone has opportunity to influence

Promise and Perils

- Promise
  - Better, more ambitious science
  - Better science education
  - Greater outreach
  - Benefits beyond science & engineering
- Perils
  - Success not inevitable as technologies evolve
  - Success is a mix of social and technical factors
  - Likely to be unanticipated effects
  - Science often on the leading edge

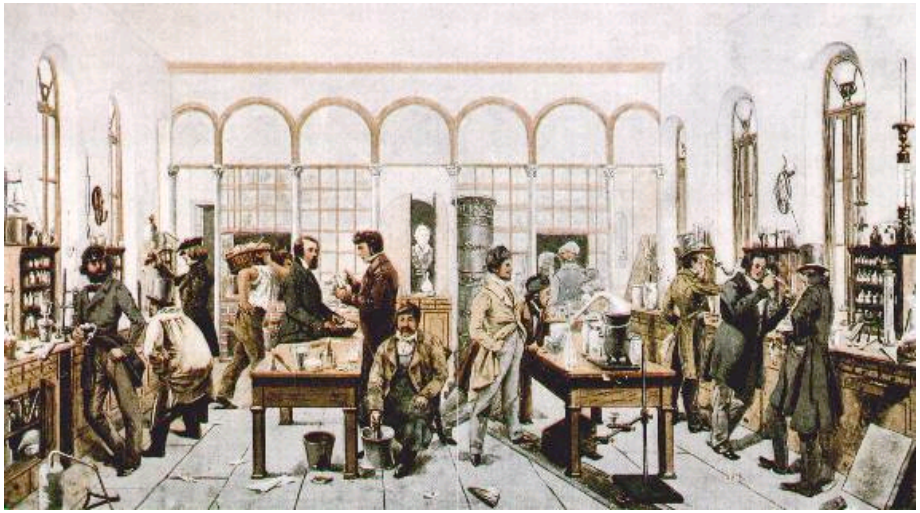
Implications of TORC

1. Suggest design of high-value technologies
2. Provide a framework for conducting evaluations
3. Serve as a tool for strategic planning



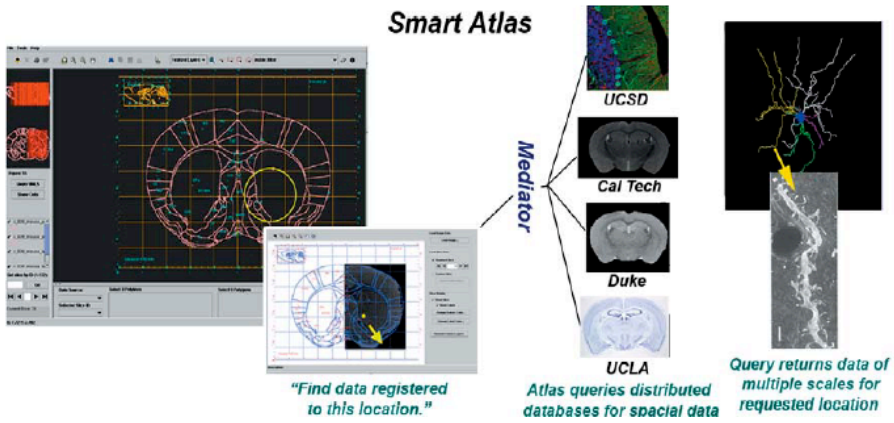
Design for high-value technologies

- One very common approach to collaborative systems design is to support constant conversation as in collocated work
- An alternate approach is to target one or more of the social processes related to success



Examples

- Ways to negotiate common ground
  - Conduct weekly technical meetings via video to report out on what each site was doing
  - Use other tools to reconcile vocabulary differences
    - BIRN brain atlas
  - Use modelling languages to “sketch”



Opportunities to improve collaboration support by…

- Tools for important social processes
- Abstract representations of information
  - Rather than mimetic approaches based on conversation
- Flexible enough to break the rules of the system

Framework for conducting evaluations

- Traditionally evaluation in science projects has focused on summative (end) evaluations
- Useful for formative (ongoing) evaluations
  - TORC as a checklist
  - E.g. Is there trust, common ground, transparent decision making process…

A tool for strategic planning

- Help organizations decide what projects to participate in.
- How to build organizational capacity for collaboration
  - Internal processes that support cross-institutional work

Summary

- Theory of Remote Collaboration
  - Variety of measures of success
  - Key features:
    - Nature of work
    - Common ground
    - Collaboration readiness
    - Management
    - Technology readiness
  - Useful for
    - Suggesting new technologies
    - Ongoing evaluation
    - Strategic Planning